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Document Revisions

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South Kesteven District Council

Strategic Flood Risk Assessment

Final Report

June 2009

Entec UK Limited
Executive Summary

This document provides an updated Strategic Flood Risk Assessment for South Kesteven District. An SFRA was originally produced for South Kesteven by Bullens Consultants in 2004. This update was required due to the emergence of Planning Policy Statement 25: Development and Flood Risk, and revisions to Environment Agency fluvial flood modelling.

The SFRA has considered all sources of flooding across South Kesteven, and the areas in which they constitute a risk. There are areas at risk of fluvial flooding associated with the two main river systems in the district (the Witham and the Welland). Historic records show that incidences of surface water flooding, often from inadequate or blocked drainage, are common across the district. In addition, some localised areas experience groundwater flooding or are at risk from infrastructure failure.

Planning policy is still most strongly influenced by fluvial flood risk, due to the clearer definition of areas at risk in comparison to other sources of flooding. The Environment Agency’s Flood Zones are the main source of information in applying the Sequential Test, as defined by PPS25. Potential allocation sites have been plotted on maps to show their location in relation to Flood Zones 2 or 3. This has shown that although a number of sites do overlap with Flood Zones 2 or 3, in the majority of cases only a small proportion of the site is at risk of fluvial flooding. This indicates that application of the sequential test should be able to successfully steer the majority of development in to Flood Zone 1.

A more detailed ‘Level 2’ assessment of flood risk in Grantham has shown that in addition to fluvial flood risk, a number of potential development sites are at risk from other sources of flooding. Wherever possible, these additional sources should be incorporated in to the sequential test or highlighted as a focus for site-specific flood risk assessments. Groundwater flooding is known to occur on Harrowby Hill: in this case it is likely that the recommendation of flood resistance measures will be more appropriate than restrictions to development. An area downstream of Great Gonerby has also been identified to be at risk of flooding from infrastructure failure, and this should be accounted for in planning decisions.

A number of historic problem areas with surface water management have been highlighted in Grantham, as well as in other towns and villages across the district. In order to improve the management of surface water in Grantham, all new developments should aim to reduce runoff to greenfield rates wherever possible. Statements regarding the disposal of surface water will be required for all planning applications, and Flood Risk Assessments will be required for all new developments in Grantham greater than 0.5 ha. The need for introducing a similar requirement for other parts of the district will be considered when Level 2 assessments are carried out in those areas.
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1. Introduction

1.1 Background

The purpose of this Strategic Flood Risk Assessment (SFRA) is to assess flood risk across South Kesteven District, and in particular the flood risks associated with areas being considered for future development as part of the emerging Local Development Framework (LDF). This report provides an update to the 2004 SFRA by Bullens Consultants. An update was required in order to comply with the requirements of Planning Policy Statement 25: Development and Flood Risk (PPS25), which was not in existence at the time of the original SFRA. In addition, new information regarding potential development sites and requirements for the Core Strategy has necessitated this update.

Planning is driven by legislation and guidance developed at national, regional and local levels and flood risk is one of many factors to consider when making decisions relating to land use. The overarching planning guidance for considering flood risk is PPS25, which states that it is a requirement for local authorities to produce a SFRA. The challenge is to develop pragmatic principles for steering future sustainable development without conflicting with the requirements of the different planning policies.

Recent flooding events in both mainland Europe and the UK are further driving the recognition of flood risk as a major planning consideration. The ‘Making Space For Water’ report published by DEFRA (2005), identified the severe flooding in mainland Europe in 2000 as a catalyst for the Government to provide robust guidance for flood risk management. A new approach to managing surface water promoting sustainable drainage through better coordination and planning is presented in the more recent ‘Future Water’ publication by DEFRA (2008), and the principles and recommendations have been set out in the Pitt Review of the 2007 floods. The Review promotes a risk-based approach to investment in flood risk management, not simply focussed on the areas impacted by last summer’s floods. The Review also promotes natural processes to manage surface water. These recently published documents, in combination with recent high-profile flood events across the United Kingdom, have kept flood risk in the public eye and have made effective consideration of flood risk in the planning process even more important.

In December 2008 the Government published their response to the Pitt Review, which includes progress towards clearly defining the responsibilities of all parties, particularly the Environment Agency and Local Authorities, in planning for and responding to flooding. The responsibilities of local authorities will be introduced in to legislation through the Floods and Water Bill, a draft of which is expected in the spring of 2009.

1.2 Scope and Objectives

The objectives of the SFRA are to meet the requirements of PPS25 and in doing so to provide the necessary information to South Kesteven District Council to inform planning decisions. Although the flood risk-related planning needs of the Council were originally addressed in an SFRA produced in 2004, more recent developments
including PPS25 and the Pitt Review of the 2007 summer floods have provided new focus to the need for flood risk management. In particular for South Kesteven this includes:

- A comprehensive understanding of all flood risks, in particular including surface water and groundwater flooding in addition to fluvial risks;

- An SFRA undertaken at two levels: an overview assessment (Level 1) and a more detailed investigation (Level 2). This report includes a level 2 assessment only for Grantham, which the Council require to inform the Core Strategy. Level 2 assessments for other areas of the district will be undertaken at a later date, to inform the Site Specific Allocations and Policies Development Plan Documents (DPDs) and the Area Action Plans (AAPs).

1.3 Structure of the SFRA

The report is structured to present the two levels of assessment, incorporating the information required by PPS25:

- Section 2 provides the planning context for the SFRA, including drivers at the national, regional and local level;

- Section 3 provides an overview of fluvial flood risks to the district, based on the Environment Agency’s flood mapping;

- Section 4 describes the potential “other sources” of flooding in the district, including surface flooding, groundwater flooding, and the risk of flooding from infrastructure failure;

- Section 5 discusses the likely impact of flood risk on planning in the district, based on potential allocation sites provided by the council;

- Section 6 discusses the management of surface water at a district-wide scale. Flood resistance and resilience measures, for any developments that do have to be located in an area at significant risk of fluvial or groundwater flooding, are also discussed;

- Section 7 provides the Level 2 assessment for Grantham, including discussion of the flood risk requirements in the two proposed urban extension areas, and the management of surface water throughout the town.
2. Planning Context

Preparation of this SFRA has taken place in a period during which planning authorities have been implementing the provisions of the Planning and Compulsory Purchase Act 2004 and accompanying planning guidance, including PPS1 (Planning Policy Statement 1 – Delivering Sustainable Development) and PPS 12 (Planning Policy Statement 12 – Local Development Frameworks). These affect all tiers of the planning system and have necessitated major changes at both the regional and local level, which will impact on the way in which planned development is reflected in the regional strategy and delivered locally.

Changes to the planning policy process will see the South Kesteven Local Plan replaced by a Local Development Framework (LDF). The LDF comprises a framework of documents including the Core Strategy, Development Plan Documents (DPDs), Site Specific Policies and Proposal Maps, Statement of Community Involvement (SCI) and Supplementary Planning Documents (SPD). The SFRA will form background evidence to some of these documents.

2.1 National Planning Policy

2.1.1 Planning Policy Statement 25: Development and Flood Risk

This SFRA has been undertaken in accordance with the guidance provided in Planning Policy Statement 25 – Development and Flood Risk (PPS25) and its accompanying Practice Guide. Box 1 presents a summary of the planning objectives presented in PPS25.

Central to the policy statement is a sequential risk-based approach to guide development into areas of lowest flood risk where possible, which should be applied at all levels of the planning process. The ‘Sequential Test’ in Annex D of PPS25 should be applied to show that no other suitable sites in lower flood risk areas are available when considering individual planning applications. The sequential test also accounts for the “vulnerability” of a development depending on its proposed use, being most stringent in steering highly vulnerable developments away from areas at risk of flooding.

PPS25 also introduces the Exception Test, which allows the potential for development to be considered in areas at risk of flooding if there are no suitable sites available in areas of lower flood risk. The criteria for exception include where the development makes a positive contribution to sustainable communities, and redevelopment of brownfield land. Exceptions can be permitted where it can be demonstrated that the development will be “safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall”. Figures 4.1 and 4.2 from the PPS25 Practice Guide (shown in Appendix A) outline the process for Local Authorities to undertake the Sequential and Exception Tests.
Creating the environment for business

PPS25 also sets out the need to consider other sources of flood risk (such as groundwater, overland flow and sewer) in addition to the main fluvial and tidal sources. The implications of climate change on flood risk also require consideration in the interest of sustainable development.

<table>
<thead>
<tr>
<th>Box 1</th>
<th>Summary of PPS25 Planning Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through PPS25, the Government has sought to provide clarity on what is required at a regional and local level to ensure that appropriate and timely decisions are made to deliver sustainable planning for development. The key planning objective as stated in PPS25 is that:</td>
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<tr>
<td>Regional Planning Bodies (RPBs) and LPAs should prepare and implement planning strategies that help to deliver sustainable development by:</td>
<td></td>
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<tr>
<td>• APPRAISING RISK</td>
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<tr>
<td>Identifying land at risk and the degree of risk of flooding from river, sea and other sources in their areas;</td>
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</tr>
<tr>
<td>Preparing Regional Flood Risk Appraisals (RFRAs) or Strategic Flood Risk Assessments (SFRAs) as appropriate, as freestanding assessments that contribute to the Sustainability Appraisal of their plans;</td>
<td></td>
</tr>
<tr>
<td>• MANAGING RISK</td>
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</tr>
<tr>
<td>Framing policies for the location of development which avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change;</td>
<td></td>
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<tr>
<td>Only permitting development in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and benefits of the development outweigh the risks from flooding;</td>
<td></td>
</tr>
<tr>
<td>• REDUCING RISK</td>
<td></td>
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<tr>
<td>Safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of flood water, and flood defences;</td>
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<tr>
<td>Reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SuDS);</td>
<td></td>
</tr>
<tr>
<td>Using opportunities offered by new development to reduce flood risk to the causes and impacts of flooding e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SuDS; re-creating functional floodplain; and setting back defences;</td>
<td></td>
</tr>
<tr>
<td>• A PARTNERSHIP APPROACH</td>
<td></td>
</tr>
<tr>
<td>Working effectively with the Environment Agency and other stakeholders to ensure that best use is made of their expertise and information so that decisions on planning applications can be delivered expeditiously; and Ensuring spatial planning supports flood risk management and emergency planning.</td>
<td></td>
</tr>
</tbody>
</table>

The Town and Country Planning (Flooding) (England) Direction 2006 has made the Environment Agency a Statutory Consultee on all applications for development in flood risk areas, including areas with critical drainage problems and for developments exceeding 1 hectare outside of flood risk areas. After discussion with the Environment Agency, LPAs are required to notify the Secretary of State if they remain minded to approve a planning application contrary to a sustained objection from the Environment Agency.

2.1.2 Planning Policy Statement 1: Delivering Sustainable Development

Published in February 2005, this document sets out the overarching planning policies for the delivery of sustainable development across the planning system. PPS1 explicitly states that development plan policies should take account of flooding. It proposes that the new development in areas at risk of flooding should be avoided. Planning authorities are also advised to ensure that developments are sustainable, durable and adaptable. This should be achieved through taking into account natural hazards such as flooding.
PPS1 also places an emphasis on spatial planning, in contrast to the more rigid land use planning approach which it supersedes. LPAs will still produce site-specific allocations and a proposals map as part of Local Development Documents (LDDs). The Core Strategies will be more strategic and visionary in content and will take into account the desirability of achieving integrated and mixed use development, whilst considering a broader range of community needs than has historically been the case. It will be important for the Core Strategies and accompanying supplementary planning documents to recognise the contribution that non-structural measures can make to effective flood management.

2.1.3 Supplement to PPS1 – Planning and Climate Change

Since the publication of PPS1 the Government has published a supplement to PPS1 called Planning and Climate Change. This supplement sets out how planning should contribute to reducing emissions and stabilising climate change and taking into account the consequences. The PPS1 supplement advises local planning authorities that when deciding suitable locations for development, and for what type and intensity of development, they should consider physical and environmental constraints such as sea level rise, flood risk and stability, and take a precautionary approach to increases in risk which may arise as a result of potential changes to the climate.

2.2 Regional Planning Policy

2.2.1 The East Midlands Regional Plan Proposed Changes

The East Midlands Plan revises the current Regional Spatial Strategy for the East Midlands (RSS8) and sets out the future broad development strategy for the region covering the period to 2026.

It provides a spatial framework to inform the preparation of local development documents, local transport plans and regional and sub-regional strategies and programmes that have a bearing on land use activities. It forms part of the development plan for the purposes of determining planning applications and has a statutory force under the new Planning and Compulsory Purchase Act. It identifies the scale and distribution of new housing and priorities for the environment, transport, infrastructure, economic development, agriculture, energy, minerals, and waste treatment and disposal.

RSS8 was published by the Secretary of State in March 2005 and the Assembly began to review the strategy in 2006. The draft East Midlands Plan has subsequently been submitted to the Secretary of State and undergone consultation and examination. The plan, with the Secretary of State’s proposed changes, was published for consultation in July 2008 and is expected to be adopted late 2008 or early 2009. This will then supersede the region’s adopted Structure Plans. Meanwhile, the Assembly has been asked by Government to undertake a further Partial Review on key issues including housing provision, transportation and climate change issues. This commenced on 17th October 2008 and looks at these issues up to 2031.
The emerging RSS divides the East Midlands region into five sub-areas which are then further divided into Housing Market Areas (HMAs).

South Kesteven is located within the Eastern sub-area of the East Midlands. Grantham, the main urban centre of the District, is identified in the plan as a sub regional centre and is one of the Government’s new Growth Points. For housing priorities it also falls under the Peterborough Partial Housing Market Area which seeks to strengthen the sub regional role of Grantham and consolidate the local role of Stamford.

Policy 13 of the plan sets a target of 16,800 dwellings to be built in South Kesteven in the period 2001 to 2026. This target is divided up into annual build rates of between 640 and 700 spread over 5 year periods.

The plan recognises the need for a regional approach to managing flood risk and land drainage, especially after the extensive flooding which occurred in 2000/01, which highlights its importance as a key future spatial planning issue. Policy 35 of the plan states that the LDF should take account of the potential impact of climate change on flooding and land drainage which will be informed by this SFRA.

2.2.2 East Midlands Regional Flood Risk Appraisal

A Regional Flood Risk Appraisal (RFRA) was produced for the East Midlands region by Faber Maunsell in 2006. This was produced prior to the release of PPS25, and hence may not cover all the requirements and considerations now included in PPS25. This compiled information from the Environment Agency, Local Planning Authorities and Internal Drainage Boards regarding the proportional importance of flood risk in planning.

South Kesteven District Council was included in the RFRA, as a component of the Peterborough partial housing market area. Information regarding the risk of flooding in the district was based on the district council’s own perception: on a scale of one (not important) to ten (very important), SKDC graded the significance of flood risk in their district as eight. The RFRA included the following further conclusions about South Kesteven:

- Medium probability of flooding from “primary” (main river) sources, but the consequences would be low because the areas affected would be predominantly rural;
- Medium risk of flooding from “secondary” (IDB arterial drainage) sources;
- Low residual (i.e. the residual risk of flooding behind defences, if the defences failed or were overtopped) risk of flooding.

The RFRA did not give any consideration to flooding from other sources such as surface runoff or groundwater, which are given a much greater emphasis under PPS25.
2.3 Local Planning Policy

2.3.1 Local Plan

The South Kesteven Local Plan was adopted in April 1995 and covered the period up to 2001. The Local Plan is being reviewed and gradually it will be replaced by the South Kesteven Local Development Framework. Policies in the Plan were automatically saved for a three year period until September 2007 under the provisions of the Planning and Compulsory Purchase Act 2004. Forty five of the policies were ‘saved’ beyond this date by a Direction issued by the Secretary of State on 24th September 2007. These remain valid until replaced by new policies through the LDF process.

2.3.2 Local Development Framework

South Kesteven District Council is currently preparing its Local Development Framework, which will set out the Council’s future planning policies for the District covering the period to 2026. The Council has already started to prepare its Core Strategy Development Plan Document (DPD), which will outline the overarching spatial strategy and core policies for the district. This document will also identify the location of urban extensions to deliver the development in Grantham under the Growth Point Agenda.

The Council consulted on the Preferred Options of the Core Strategy in June/July 2006. Following the first examinations of Core Strategies nationally the Council took the decision to undertake the preferred options consultation again, to minimise the risk of the document being judged “unsound” at examination. This consultation was carried out in May 2007 and the submission document will be published shortly. Objective 13 of the Core Strategy Preferred Options document seeks to ‘ensure that new development is not exposed unnecessarily to the risk of flooding, and does not create a risk of flooding elsewhere’. One of the Council’s preferred options is therefore to reduce the risk of flooding and Preferred Option PO11 states that permission will not be granted where development would be likely to increase the risk of flooding; increase the risk to people and properties; or have an adverse effect upon flood defences. The Core Strategy is due to be adopted in December 2009.

Other Local Development Documents which are in early preparation are the Site Specific Allocations DPD; an Area Action Plan for Grantham; and Supplementary Planning Documents. The Site Allocations document will set out site specific policies for particular development proposals in the district. The Area Action Plan for Grantham will provide a detailed planning framework for the town’s proposed areas of change and areas of conservation. These are due to be adopted in June 2011.

This SFRA will form part of the evidence base for the Core Strategy and other DPDs to ensure they are ‘sound’, as required by PPS12. The SFRA will specifically inform policy development relating to flooding and locations for new development.
2.3.3 Existing SFRA

A Strategic Flood Risk Assessment (SFRA) was produced for South Kesteven District Council by Bullens Consultants in 2004, under the guidance of Planning Policy Guidance 25 (PPG25), which preceded PPS25. The SFRA focussed on fluvial flood risks across the district. It also gave some consideration to surface runoff and its management, particularly in assessing whether Sustainable Drainage Systems (SuDS) were likely to be appropriate for each of 34 individually discussed potential allocation sites.

In the conclusions of the 2004 SFRA, it was recommended that hydraulic models should be developed of both the Rivers Welland and Witham: since the report was written in 2004, those models have been developed and new Flood Maps produced (although these do not currently include the tributaries of Mow Beck or Barrowby Stream in the River Witham catchment). Updating the SFRA therefore allows the most recent modelling to be incorporated in to the Council’s spatial planning.

2.4 Environment Agency Policy

The Environment Agency has produced Catchment Flood Management Plans (CFMPs) for both of the main river catchments in South Kesteven district: the Witham and the Welland. These detail the Environment Agency’s policies with regards to the maintenance of flood defences and wider flood management practices. The final CFMPs had not been published at the time of writing the SFRA, but once published will be available on the Environment Agency’s website (where the draft summaries can currently be found):

http://www.environment-agency.gov.uk/research/planning/33638.aspx

The main policies contained within the CFMPs have been obtained from the Environment Agency, and those relevant to South Kesteven are summarised in Table 2.1.

---

1 Environment Agency webpage with links to draft plans valid 23/02/2009
### Table 2.1 Summary of CFMP Policies relating to South Kesteven

<table>
<thead>
<tr>
<th>CFMP</th>
<th>Policy Unit</th>
<th>Policy Option</th>
</tr>
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<tbody>
<tr>
<td>Welland</td>
<td>2, Welland and Glens</td>
<td>Policy Option 2: to reduce existing flood risk management policies (accepting that flood risk will increase with time)</td>
</tr>
<tr>
<td></td>
<td>3, Fenlands</td>
<td>Policy Option 4: take further action to sustain the current flood risk in to the future (responding to the potential increases to flood risk from urban development, landuse change and climate change)</td>
</tr>
<tr>
<td></td>
<td>6, Stamford</td>
<td>Policy Option 3: continue with existing and alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from the baseline)</td>
</tr>
<tr>
<td>Witham</td>
<td>Grantham</td>
<td>Policy Option 2: to reduce existing flood risk management policies (accepting that flood risk will increase with time)</td>
</tr>
<tr>
<td></td>
<td>Upper Witham</td>
<td>Policy Option 2: to reduce existing flood risk management policies (accepting that flood risk will increase with time)</td>
</tr>
<tr>
<td></td>
<td>Limestone Ridge</td>
<td>Policy Option 1: no active intervention</td>
</tr>
<tr>
<td></td>
<td>Fens</td>
<td>Policy Option 4: take further action to sustain the current flood risk in to the future (responding to the potential increases to flood risk from urban development, landuse change and climate change)</td>
</tr>
<tr>
<td></td>
<td>Sleaford and Ancaster</td>
<td>Policy Option 3: continue with existing and alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from the baseline)</td>
</tr>
</tbody>
</table>

Note: Where policies propose maintenance or improvements this will be dependant on the future availability of funding.
3. Overview of Fluvial Flood Risks

3.1 Introduction

South Kesteven is located predominantly within the hydrological catchments of the Rivers Welland and Witham and their tributaries, with a very small area on the western district boundary falling within the catchment of the River Trent. The main rivers in the district are shown in Figure 1. This section describes the risk of fluvial flooding associated with those rivers.

3.2 PPS25 Flood Zones

The Environment Agency produces maps covering the whole of England, which show the areas of land at risk of fluvial and tidal flooding. These maps have been derived by hydraulic modelling, and show the Flood Zones that are defined by PPS25:

- Flood Zone 3- areas at risk of flooding from a 1% annual probability event, also known as a 1 in 100 year return period (except in areas of tidal flooding, which is not applicable to South Kesteven). Flood Zone 3 is separated into Zones 3a and 3b, which are discussed in Section 3.4;

- Flood Zone 2- areas at risk of flooding from between a 1%-0.1% annual probability event, or 1 in 100 to 1 in 1,000 year return period event;

- Flood Zone 1- areas at less than 0.1% annual probability (1 in 1,000 year risk) of fluvial flooding.

PPS25 restricts the development types that are appropriate in each Flood Zone, based on their vulnerability. Higher vulnerability developments are more stringently steered away from areas at risk of flooding. The detail of land use vulnerabilities and flood zone compatibility, as defined by PPS25, are presented in Appendix A, and a summary is provided in Table 3.1.

The Flood Zones are delineated based on a “without-defences” scenario, therefore representing the scenario for defences not being maintained. This may appear unrealistic for areas currently benefiting from defences, but ensures that the “residual risk”, i.e. of defences being breached or overtopped, is considered.

Figures 2 and 3 show the extent of the Flood Zones across South Kesteven. These show that across most of the district, the extent of Flood Zones 2 and 3 is narrow, due to the well-defined valleys through which the rivers flow. In contrast, the eastern edge of the district (to the east of Bourne and Market Deeping) lies within the low-lying land of the Fenlands, where Flood Zone 3 is extensive.
Table 3.1 Development and Flood Zones

<table>
<thead>
<tr>
<th>Flood Zone</th>
<th>Development Type</th>
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<tbody>
<tr>
<td>Flood Zone 1</td>
<td>PPS25 states that all uses of land are appropriate in this zone</td>
</tr>
<tr>
<td>Flood Zone 2</td>
<td>The appropriate uses of land specified by PPS25 for this zone include, water-compatible, less vulnerable, more vulnerable and essential infrastructure. The vulnerability classifications are detailed in Table D.2 of Annex D PPS25, which is reproduced in Appendix A. Highly vulnerable uses of land are only appropriate in this zone subject to the Sequential and Exception Tests being passed (as outlined in Section 2 and Appendix A).</td>
</tr>
<tr>
<td>Flood Zone 3a</td>
<td>PPS25 states that water-compatible and less vulnerable uses of land are appropriate in this zone. More vulnerable and essential infrastructure uses should only be permitted in this zone if the Exception Test is passed. Highly vulnerable development is not appropriate in this zone. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.</td>
</tr>
</tbody>
</table>
| Flood Zone 3b | Only the water-compatible uses and the essential infrastructure that has to be there (as detailed in Appendix A and PPS25) should be permitted in this zone. They should be designed and constructed to:  
  – remain operational and safe for users in times of flood;  
  – result in no net loss of floodplain storage;  
  – not impede water flows; and  
  – not increase flood risk elsewhere.  
Essential infrastructure in this zone should pass the Exception Test. |

3.3 Influence of Defences

As described above, the Flood Zones do not include the influence of defences. Figures 4 and 5 show the location of structures classified as being for flood defence in South Kesteven. They also show the areas that the Environment Agency considers to significantly benefit from defences. In these areas, the residual risk of failure of the defences must still be considered.

Flood defences are built to varying levels of protection, and in many cases would not protect against as great as a 1 in 100 year flood event (therefore not being effective at the standard of event represented by Flood Zone 3). In addition, the maintenance of defences cannot be guaranteed, and in fact in some areas the Environment Agency are advocating breaches of defences to provide improved flood storage. The areas for which this is proposed are detailed in Catchment Flood Management Plans (CFMPs). The CFMP policies for the Welland and Witham were summarised in Section 2.4. A reduction in flood management is proposed in the Welland and Glens, Grantham and Upper Witham policy units.

Although the Flood Zones can generally be taken to provide an indication of the extent of residual flood risk behind defences, there is a potentially significant area at residual risk of fluvial flooding in the Deepings that is not shown by the Flood Zones. Due to the River Welland being raised above the surrounding land, failure of flood defences could cause flooding to the north of the river, although the area is not within the Environment Agency’s Flood Zone 2 or 3. The locations of flood defences in the Deepings are shown on Figure 5. For this Level 1 assessment, a precautionary buffer of 300 m width around the Welland has been defined based on simple estimates produced by
the Environment Agency\(^2\), within which it is considered there may be a significant residual risk of flooding from the Welland. The extent of the buffer is shown on Figure 3 and in Appendix E. All developments within this area should be required to carry out a Flood Risk Assessment. A more detailed assessment of the potential extent of flooding and associated hazards should be undertaken in a Level 2 assessment for the Deepings.

### 3.4 Functional Floodplain

Functional floodplain is defined by PPS25 as “land where water has to flow or be stored in times of flood”, and is classed as Flood Zone 3b. Development in the functional floodplain could significantly impact on the ability of the floodplain to store and convey flood waters. Developments with water-compatible uses can be located in Flood Zone 3b, and Essential Infrastructure may also be appropriate, subject to passing the Exception Test. As shown in Table 3.1, these are likely to be subject to restrictions to ensure that the development does not contribute to an increased flood risk elsewhere. The Sequential Test, as presented in Appendix D, shows that no other development is suitable for Flood Zone 3b.

PPS25 recommends that the functional floodplain should be delineated by the extent of flooding for a 5% annual probability event (1 in 20 year return period) event. The modelling carried out by the Environment Agency for the Welland and Witham has not included a 5% annual probability run, so instead the outline of the 4% annual probability event (1 in 25 year) has been used to define the functional floodplain for South Kesteven. This is a precautionary approach that has been agreed with the Environment Agency.

The extent of functional floodplain is shown in Figures 6 and 7\(^3\). As for the rest of Flood Zones 2 and 3, Flood Zone 3b is generally narrow due to the surrounding topography. No Flood Zone 3b is shown in the fenlands. This is because the modelling of the functional floodplain has taken in to account defences (in accordance with the advice in the PPS25 Practice Guide), since defended land by its nature should not provide a flood storage or conveyance purpose for small flooding event\(^4\). The defended and managed nature of the Fenlands precludes them from acting as functional floodplain. They could more appropriately be defined as “passive floodplain”, which is defined in CIRIA 624: Development and flood risk- guidance for the construction industry as being “within the natural floodplain but not now subject to flooding because of the presence of flood alleviation measures”.

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\(^2\) Information received by personal communication with John Ray, Team Leader Flood Risk Mapping and Data Management, EA Anglian Region, Northern Area, 03/03/09

\(^3\) Except for Barrowby Stream and Mow Beck in Grantham, where modelling has not yet been carried out by the Environment Agency

\(^4\) 1in 25 year runs have not yet been carried out for the South Forty Foot drain. However, given the nature of the drainage system, it is assumed that this statement will also apply to the South Forty Foot.
3.5 **Impacts of Climate Change**

Climate change is likely to have a significant impact on the hydrological regime, which could affect the risk of flooding from all sources. Climate change predictions suggest that more high-intensity rainfall events will occur in the future. This will result in a higher risk of localised flooding where drainage systems are overwhelmed, and leads to higher peak river flows and hence increased fluvial flood risk.

PPS25 requires that the impacts of climate change be considered in planning. It includes likely values for changes to the hydrological regime (including tide levels, rainfall intensity and peak river flows) that could occur due to climate change. These figures should be applied to planning decisions, for example in ensuring that drainage systems have the capacity for higher intensity storms (discussed further in Section 6), and accounting for potential changes in the extent of the Flood Zones in spatial planning.

The Environment Agency is in the process of including climate change scenarios in their flood modelling. However the scenarios that have been run at this time are based on a “defended” situation, and are therefore not comparable with the current Flood Zone maps. In order to provide an interim assessment of the likely impact of climate change on fluvial flood extents, the following estimations of the impact of climate change are shown in figures 8 and 9:

- The extent of the 1 in 100 year event with climate change has been taken to be equivalent to the present day Flood Zone 2. This is a common strategy for inland areas that has also been adopted by other councils;

- The extent of the 1 in 1,000 event with climate change has been represented using a combination of the defended 1 in 1,000 year plus climate change model run and the present day Flood Zone 2. The outlines of these two scenarios were compared, and the maximum extent used.

Figures 8 and 9 show that due to the defined topography of the main river valleys, there is little change from the present-day Flood Zones across the majority of the district, and therefore that climate change will have relatively little impact on the extent of fluvial flooding in the district. However it should be noted that although in many areas the extent of flooding may change little, the depth and velocities of flood waters are likely to increase. The main area where modelling shows that the extent of flooding is likely to increase is on Foston Beck and the River Witham downstream of Grantham, particularly between Marston and Long Bennington. In addition, the extent of Flood Zone 3 will extend slightly around the edge of the fenlands and around the village of Baston.

It is recommended that Figures 8 and 9 should be updated once the undefended scenarios of the Environment Agency model have been run.

3.6 **Historic Records of Fluvial Flooding**

Both the Environment Agency and South Kesteven District Council have maintained records of historic flooding events. The information provided by SKDC relates mostly to localised flooding events other than fluvial, and these
are discussed in Section 4. The Environment Agency have provided maps of the extent of historic fluvial flooding that they have recorded, and these are shown in Figures 10 and 11. The maps appear to suggest that flooding has not historically occurred over large areas, but it is likely that this is because little information was available about flooding in rural areas. For example, the flooding shown on the River Witham through Grantham is likely also to have occurred further upstream and downstream, but the Environment Agency does not have enough information about the extent to include it on a map. The Environment Agency’s maps also may not include extents of flooding for recently “en-mained” rivers, for which they have only been responsible for a short time. Therefore Figures 10 and 11 should be used in conjunction with Figures 12 and 13 to ensure that historic records from all sources are fully considered.
4. Other Sources of Flooding

4.1 Surface Water Flooding

4.1.1 Historic Flooding Records

SKDC have provided a summary of historic flooding incidents (non-fluvial) at all known locations. Lincolnshire County Council was also contacted, for information regarding highways flooding. They provided a list of nine priority locations where they are aware of highway-related flooding, of which seven had already been identified by SKDC. All the locations identified by SKDC and LCC are shown in Figures 12 and 13. The numbers at each location on the maps correspond to the key in Appendix B. The locations have been distinguished by a generalised “source” of flooding, based on the information provided by SKDC Drainage Engineer Chris Maw. These sources are discussed in more detail in the following sections, but include:

- **Surface water flooding.** Accumulation of surface runoff from local rainfall;
- **Surcharge.** Events identified to have occurred due to blockages, backing up or inadequate capacity causing surcharge of ditches, culverts or drains;
- **Infrastructure.** Flooding occurring as a result of infrastructure failure, e.g. leakage from reservoirs or canals;
- **Groundwater.** Flooding as a result of rising groundwater levels and springs appearing.

Figures 12 and 13 show that isolated flooding events have occurred in many towns and villages across the district, with the majority being caused by surface runoff and/or surcharge or failure of drainage. Some of these were one-off incidents associated with blockages or capacity issues that have since been rectified. Further details of the cause and extent of each flooding location are provided with the key to the maps in Appendix B.

4.1.2 Indicative Modelling: Potential Risk Areas

The extent of flooding that has occurred in the past (as indicated by historic flooding records) is not necessarily representative of the extent of flooding that could occur in the future. This is partly because more extreme storm events could occur in future compared to the past. In addition, changes to land use and to drainage systems can affect the ability of rainfall to runoff or infiltrate to the ground.

In order to gain an indication of areas that could potentially be at risk of flooding from surface runoff, modelling has been carried out of the four main urban areas in South Kesteven (including Grantham, Stamford, Market Deeping and Bourne). The details of the modelling can be found in Appendix C. In summary, the model uses rainfall and topographic information to “route” a rainfall event through the urban area, determining the areas where
runoff is likely to pool or be delayed and hence be a potential cause of flooding. The model does not account for existing drainage systems, and assumes that the rainfall occurs on to an impermeable surface. Therefore this represents a very worst-case scenario. It is designed to show the main flowpaths, i.e. the route that most runoff is likely to take, and areas where pooling is likely to occur. In doing so, it indicates the areas where surface runoff has greater potential to become a critical problem, recognising that these problems are manifested at the downstream end of a wider catchment area contributing the runoff.

It is important to note that the maps should not be used as a definitive guide to where surface flooding will occur, but can be used as an indicator of whether a new development may be at risk of flooding due to runoff from surrounding areas. They can provide a useful tool for the masterplanning of large sites (determining a suitable site layout), and to identify where site-specific flood risk assessments should give more detailed consideration to surface runoff flood risks.

The results of the surface runoff modelling are shown in Figures 16 to 19. These figures also show the locations of recorded historic flooding that was attributed to surface runoff or drain surcharge. This allows comparison of areas potentially at risk of flooding to those which have experienced flooding historically. Table 4.1 summarises the locations where historic records and modelling of areas potentially prone to flooding coincide. Proposed developments in these areas should be considered particularly carefully in terms of the surface flooding risk.

### Table 4.1 Comparison of Historic Flooding Records with Surface Flood Modelling

<table>
<thead>
<tr>
<th>Town</th>
<th>Location</th>
<th>Historic problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stamford</td>
<td>Lambeth Walk</td>
<td>Historic problems with pluvial flows and inadequate drainage coincide with modelled area of flooding</td>
</tr>
<tr>
<td></td>
<td>Essex Road</td>
<td>Historic problems with pluvial flows and inadequate drainage coincide with the upper end of an area of flow convergence in the modelling</td>
</tr>
<tr>
<td></td>
<td>Northumberland Avenue</td>
<td>Historic incidences of drainage being impeded by clay soils coincide with small areas of pooling in the modelling</td>
</tr>
<tr>
<td>Bourne</td>
<td>Cemetery</td>
<td>Historic incidences of drainage being impeded by clay soils coincide with small areas of pooling in the modelling</td>
</tr>
<tr>
<td></td>
<td>Beech Avenue</td>
<td>Historic records of watercourse surcharging coincides with modelled area of flooding</td>
</tr>
<tr>
<td></td>
<td>South Road, near Drummond Road</td>
<td>Historic records of watercourse surcharging coincided with localised areas of flooding in the modelling</td>
</tr>
<tr>
<td>Grantham</td>
<td>Withambrook</td>
<td>Historic and ongoing problems with surcharging drainage coincides with modelled area of flooding</td>
</tr>
<tr>
<td></td>
<td>Maltings Lane</td>
<td>Historic records of surcharging dyke and culvert near the railway coincides with significant area of flooding in the modelling</td>
</tr>
</tbody>
</table>
4.1.3 Climate Change

As discussed in Section 3, climate change is predicted to change the hydrological regime in ways that may exacerbate flooding. PPS25 provides guidance about the expected increases in peak rainfall intensity and river flows over the next century, and the recommended allowances are shown in Table 4.2 for the relevant parameters (the whole of Table B.2 from PPS25 is included in Appendix A.) This indicates that even without new development, the pressure on existing drainage systems will become greater due to more intense rainfall events occurring. It will become increasingly important that new developments should be designed to minimise and control the rates and volumes of runoff from the site.

Table 4.2 Recommended National Precautionary Sensitivity Ranges for Peak Rainfall Intensities and Peak River Flows

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1990-2025</th>
<th>2025-2055</th>
<th>2055-2085</th>
<th>2085-2115</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak rainfall intensity</td>
<td>+5%</td>
<td>+10%</td>
<td>+20%</td>
<td>+30%</td>
</tr>
<tr>
<td>Peak river flow</td>
<td>+10%</td>
<td>+20%</td>
<td>+20%</td>
<td>+20%</td>
</tr>
</tbody>
</table>

Extract from Table B.2 of PPS25

Further information about surface water flooding and the management of surface water is discussed in Section 6.

4.2 Groundwater Flooding

Groundwater flooding occurs as a result of rising groundwater levels. This may cause flooding of basements, or at the surface where springs emerge, and is most likely to occur in areas underlain by aquifers. Groundwater flooding tends to develop relatively slowly as groundwater levels rise, but in the same way is likely to also recede slowly as levels drop again. It can be difficult to tell where groundwater flooding is likely to occur, unless known historic incidences have been recorded at the site. The Environment Agency monitors groundwater levels, and this is being used to help improve the understanding of groundwater flood risks, particularly following the recommendations of the Pitt Review5.

Figures 14 and 15 show the simplified geology of the district, highlighting only the areas of aquifer. They show that large areas of the district, extending from the eastern edge of Grantham and south through Stamford, are underlain by the Lincolnshire Limestone aquifer. Springs are found around this area, and flooding may develop in low-lying areas when high groundwater levels reach the surface. It should be noted that some areas of the

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5 Pitt Review Recommendation 2: The Environment Agency should progressively take on a national overview of all flood risk, including surface water and groundwater flood risk.
limestone are overlain by less permeable drift deposits, reducing the risk of groundwater flooding occurring at the surface. Isolated outcrops of limestone also occur in the eastern part of the district, for example in Bourne a spring forms the source of the Bourne Eau.

To the west and east of the limestone band, the geology is dominated by clays and mudstones, and groundwater flooding is less likely in these areas, except where permeable drift and superficial sediments are found near the surface. In the southeast of the district, around the Deepings, the superficial geology is dominated by permeable sands. Again, rising groundwater levels in these deposits may result in flooding at the surface.

Figure 14 shows that there have been a number of previous incidences of groundwater flooding on Harrowby Hill in East Grantham (also known as the “Hills and Hollows” area). Comparison to the geology shows that these occur around the edge of the limestone, where it meets the clay and groundwater is forced to the surface. Therefore it is likely that similar flooding could occur along all the hillside at the same level.

Flooding relating to increased groundwater levels has also been recorded in Allington, although this was also in relation to a surcharged ditch, so it was not clear which was the primary cause of flooding. SKDC do not have any other records of historic groundwater flooding, although it is possible that other cases could have occurred but were not identified as being caused by groundwater. The Welland Catchment Flood Management Plan identifies Bourne as being at risk of groundwater flooding. Information from the Environment Agency suggests that groundwater-associated flooding in Bourne may occur when high groundwater levels cause large spring discharges to the Bourne Eau, causing connected watercourses to overtop.

4.3 Flooding from Infrastructure

Flooding could potentially occur as a result of the failure or leakage of infrastructure such as canals and reservoirs. Three potential areas where infrastructure failure could cause or has previously caused flooding have been identified:

- A 1 km stretch of the Grantham Canal in Grantham has historically had problems of leakage through the bank, resulting in flooding of at least 2 residential properties. This is being addressed through bank reinforcements by SKDC;

- A balancing lagoon built in Great Gonerby (Lord Drive) to attenuate runoff from a new development is considered to be of insufficient capacity. Overtopping has occurred, and SKDC have ongoing concerns about the bank stability. The restrictions this places on development in the vicinity are discussed in greater detail in Section 7;

- Denton Reservoir, to the southwest of Grantham, was identified by the Environment Agency as a potential source of flooding to the north if it were to fail. However, the reservoir was constructed to supply water to the Grantham Canal, which is immediately to the north of the reservoir. Any failure of the reservoir is likely to be interlinked with the canal and cannot be considered independently. No
Concerns have been expressed about the condition of the canal in this area, and it is being actively managed and restored by the Grantham Canal Partnership⁶. The water levels in the canal are controlled by weirs, locks and sluices. This management reduces the probability of failure and would limit the spatial extent of any failure if one were to occur.

Further details regarding the flood risks associated with infrastructure failure in Grantham are provided in Section 7.

4.4 Summary of Flood Risks

Sections 3 and 4 have described all the potential sources of flood risk present in South Kesteven district. These are summarised in Table 4.3.

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluvial flooding:</td>
<td>Out-of-bank flow</td>
<td>Long Bennington, Westborough, Hougham, Marston, Barkston, Great Ponton, Grantham, Colsterworth, North Witham, South Witham</td>
</tr>
<tr>
<td>Witham</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Witham tributaries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Glen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Glen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>River Glen and Bourne Eau</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Forty Foot Drain and tributaries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional areas at residual risk of fluvial flooding:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welland</td>
<td>Failure of flood defences</td>
<td>Market Deeping and Deeping St James</td>
</tr>
<tr>
<td>Rainfall</td>
<td>Accumulation of surface runoff and insufficient drainage capacity</td>
<td>All areas of hardstanding or poor drainage, particularly in topographic lows</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Rising groundwater levels. Intermittent emergence of springs</td>
<td>Grantham “Hills and Hollows” area (Harrowby Hill)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bourne</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allington</td>
</tr>
</tbody>
</table>

Table 4.3 (continued)  Potential Sources of Flooding in South Kesteven

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrastructure:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grantham Canal</td>
<td>Leakage or bank failure</td>
<td>Grantham Canalside</td>
</tr>
<tr>
<td>Lord Drive balancing pond</td>
<td></td>
<td>Currently undeveloped areas between Great Gonerby and Manthorpe</td>
</tr>
</tbody>
</table>
5. Flood Risk Management Through Planning

5.1.1 Sequential Approach

PPS25 (paragraph 16) requires that:

“LPAs allocating land in LDDs for development should apply the sequential test... to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development of land use proposed”

The Sequential Test is further explained in Sections 4.11-4.39 of the Practice Guide. Different types of developments are classed as having different “vulnerabilities”, with highly vulnerable developments steered more stringently away from areas of greater flood risk. The flood risk and vulnerability classification tables from Appendix D of PPS25 are reproduced in Appendix A of this report for ease of referencing. Ideally, all new developments should be located in Flood Zone 1. When all the available land in Flood Zone 1 has been assigned (with the emphasis on locating the highest vulnerability developments first), sites in Flood Zone 2 and finally, if necessary, Flood Zone 3 can be allocated.

In order to assist with the sequential testing process, maps have been produced which show the flood risk at each potential allocation site. This allows sites that are wholly or partly within Flood Zones 2 or 3 (i.e. considered to be at significant risk of fluvial flooding) to be identified and highlighted for further consideration. In addition to performing the sequential test, this is useful for the planning of individual sites, to determine whether a Flood Risk Assessment is required.

It should be noted that the sequential test will be based primarily on the fluvial flood risk classifications. However any site-specific information regarding other sources of flooding (as discussed in Section 4) should also be taken in to account if possible.

5.1.2 Maximum Flood Risk at a Site

At its simplest level, the sequential test encourages preferential development away from any site which is even partly in Flood Zones 2 or 3. In order to provide an initial assessment of where further consideration of flood risk is necessary, Figures 22 to 31 (left hand map of each figure) show the maximum flood risk that occurs in all the potential allocation sites. As noted above, these maps are based only on the extent of the fluvial flood zones. Other sources of flooding are considered in more detail for specific development sites in the Level 2 assessment for Grantham.
The sites have been colour coded according to the Flood Zones with which the site intersects. In order to highlight the risk of flooding in each zone, a traffic-light system has been used. Sites coloured green are located entirely outside Flood Zones 2 and 3 and are therefore at lowest risk of flooding, so the most vulnerable developments should be assigned to these locations as per the sequential test. Details of appropriate land uses for each Flood Zone can be found in Table 3.1 and Appendix A of this report, or Appendix D of PPS25. Sites coloured yellow, orange or red overlap with or are entirely covered by Flood Zones 2, 3a or 3b respectively. The maps show that of 369 total potential allocation sites:

- 23 have a maximum flood risk of Flood Zone 3b;
- 29 intersect with Flood Zone 3a;
- 12 with Flood Zone 2;
- An additional 19 sites overlap with the precautionary area identified in the vicinity of Mow Beck and Barrowby Stream. These sites should be reassessed once modelling has been carried out.

The remaining 78% of the potential allocation sites are entirely within Flood Zone 1.

It should be noted that where the floodplain is narrow, but a proposed development site overlaps with Flood Zones 2 or 3, this can appear to suggest a disproportionately large area at risk of flooding. The maps are still relevant in this case to highlight the need for further consideration of flood risk, however for larger sites a sequential approach can then be applied within a site, as described below.

5.1.3 Distribution of Flood Risk Within a Site

The sequential test can first be applied to whole sites, to provide the most effective and efficient avoidance of development in areas of flood risk. However for larger areas allocated for development or regeneration, this could be highly restrictive. This is particularly evident in South Kesteven where the floodplains are generally narrow but some potential site allocations are located close to the river. The right hand map on each of Figures 22 to 31 therefore show the distribution of flood risk within each site, again using a traffic light colour scheme. These can be used to apply the sequential approach within a site, by steering all, or at least the most vulnerable, development away from the areas of flood risk. Specific examples of this are discussed in the Level 2 assessment in Section 7.

These maps show that it should be possible for the majority of developments in South Kesteven to be located in Flood Zone 1. For sites overlapping with Flood Zones 2 or 3, generally only a small proportion of the site is within the areas of significant flood risk, and in these cases the developed areas should be located as far as possible in the parts of the site that lie within Flood Zone 1. The main areas where this may prove restrictive to development (based on the proportion of site area or potential development area in a town or village covered by Flood Zone 2 or 3) include:

- Currently undeveloped area to the northeast of Bourne, near Dyke;
• The majority of the potential allocation sites in Baston;

• The Canal Basin area of Grantham may be affected, depending on the outcome of modelling of the Mow Beck.

**Figures 22 to 31** should be referred to for further details of individual sites.

It may be noticed that a small number of the suggested allocation sites in **Figures 22 to 31** are highlighted as having a maximum flood risk of Flood Zone 3b, but in the distributed flood risk maps, no area of Flood Zone 3b can be seen. This has occurred where there is only a slight overlap between Flood Zone 3b and the site boundary, which does not always show up in the resolution of the mapping. Although such a small overlap ultimately may not restrict development on the site (e.g. if the majority of the site is outside Flood Zones 2 and 3), the red highlight on these sites has been retained as a precautionary measure to highlight proximity to a watercourse and area of flood risk. SKDC and the Environment Agency should be contacted regarding the requirements for site-specific FRAs at these sites.
6. **Flood Risk Management Through Design**

6.1 **Introduction**

The PPS25 practice guide introduces a hierarchy of flood risk management (Table 6.1). This reinforces the preference for the *avoidance* of flood risks, but recognises that it may not always be possible to avoid all risks (particularly for surface water flooding) and therefore sets out the appropriate procedures for management. Sections 3 to 5 of this SFRA have provided the necessary information required for Steps 1-3 of the hierarchy. This section provides further details to, where necessary, allow the control and mitigation of flood risk in development (i.e. Steps 4 and 5).

<table>
<thead>
<tr>
<th><strong>Table 6.1  Flood Risk Management Hierarchy introduced by PPS25 Practice Guide</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLOOD RISK MANAGEMENT HIERARCHY</strong></td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
</tr>
<tr>
<td>Assess</td>
</tr>
<tr>
<td>Appropriate flood risk assessment</td>
</tr>
</tbody>
</table>

6.2 **Surface Water Management**

Surface water management falls under Step 4 of the flood risk management hierarchy, being necessary in order to control the risk of flooding from rainfall runoff. This section discusses the factors that contribute to surface water flooding, and the control measures that can be used to reduce that risk.

6.2.1 **Influence of Ground Permeability**

In considering the risk of surface water flooding, the permeability of the soil and underlying geology are of great importance. This permeability is indicated by the “infiltration potential” mapped in Figures 20 and 21, which has been determined using a simplified version of the Groundwater Vulnerability maps produced by the Environment Agency, as described in Table 6.2.
Table 6.2 Infiltration Potential Derived from Groundwater Vulnerability Classification

<table>
<thead>
<tr>
<th>Aquifer Type_Soil Leaching Potential</th>
<th>Description</th>
<th>Infiltration Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non_Aquifer</td>
<td>No groundwater body present</td>
<td>Low</td>
</tr>
<tr>
<td>Minor_Low</td>
<td>Variably permeable, with low leaching potential</td>
<td>Low</td>
</tr>
<tr>
<td>Minor_Intermediate</td>
<td>Variably permeable, with intermediate leaching potential</td>
<td>Low</td>
</tr>
<tr>
<td>Major_Low</td>
<td>Highly permeable, with low leaching potential</td>
<td>Low</td>
</tr>
<tr>
<td>Minor_High</td>
<td>Variably permeable, with high leaching potential</td>
<td>Medium</td>
</tr>
<tr>
<td>Major_Intermediate</td>
<td>Highly permeable, with intermediate leaching potential</td>
<td>Medium</td>
</tr>
<tr>
<td>Major_High</td>
<td>Highly permeable, with high leaching potential</td>
<td>High</td>
</tr>
</tbody>
</table>

In catchments where the soil type has a low infiltration potential (i.e. a high runoff potential), there is an inherent risk of surface flooding or ponding in flat or low-lying areas of the catchment, even in undeveloped areas. Figures 20 and 21 show that a significant proportion of the district has a low infiltration and high runoff potential, which is due to the clay cover. This applies mostly to the area northwest of Grantham, the fenlands east of Bourne, and the area around Aslackby.

In catchments where the soil and geology types result in a high infiltration potential, there is generally little risk of surface flooding in undeveloped areas, and so the introduction of development and associated impermeable surfaces can cause a more notable increase in runoff compared to those areas where the soil type is already relatively impermeable. Figures 20 and 21 show that the areas of greatest infiltration potential overlie the limestone aquifer, including a band from Fulbeck Heath to east Grantham to Stoke Rochford in the west of the district, and areas around Corby Glen, Creeton, Little Bytham and Stamford. The sands around Market Deeping (shown in Figure 21 as an area of intermediate infiltration potential) are also known to be efficient at infiltrating rainfall runoff.

6.2.2 The requirement for Surface Water Management in Planning

PPS25 requires new developments to manage surface runoff. This need has been heightened since the summer floods of 2007, with the Pitt Review recommending greater emphasis on and coordination in dealing with surface flooding. Appendices B and F of PPS25, and the accompanying Practice Guide, make the following minimum requirements regarding surface runoff:

- All proposed developments greater than 1 ha must undertake a Flood Risk Assessment (FRA), even if they are not located in Flood Zone 2 or 3;
- Surface runoff in new developments must be managed so that it does not exceed the rate of runoff from the existing development or from the greenfield rate, if the site was not previously developed;
• Management of surface runoff must include an allowance for climate change (based on the scenarios described in Section 4.1), to cover the expected lifespan of the development (a 100 year lifetime for residential and 75 years for commercial or industrial development is generally assumed);

• Surface runoff should be managed using Sustainable Drainage Systems (SuDS) “as far as is practicable”.

These requirements will be enforced through the planning process for proposed developments across the District, and all planning applications will be required to show that the management and disposal of surface water has been considered. Where necessary, the Council will consult the Environment Agency and Internal Drainage Boards to assess whether the method of disposal is appropriate. The relevant IDB will be consulted if a development is within the IDB boundary. The Environment Agency will be consulted for all new developments greater than 1 ha, which require a FRA. The Council may also require a FRA for sites smaller than 1 ha if there have been known historic problems with drainage in the area: this can be assessed by reference to Figures 12 and 13. The Environment Agency’s “Standing Advice” provides guidance for sites smaller than 1 ha, as well as other general advice on flood risk and consultation requirements. The Standing Advice can be found at:

http://www.environment-agency.gov.uk/research/planning/82584.aspx

The need for more stringent requirements in terms of runoff rates and their enforcement should be given consideration in Level 2 Assessments: this is undertaken for Grantham in Section 7 of this report. The risks and historic problems of surface flooding should be taken into account when determining whether Level 2 assessments are required.

6.2.3 Sustainable Drainage

As introduced in Section 6.1, the use of Sustainable Drainage Systems (SuDS) is required wherever possible in new developments. SuDS are designed to manage runoff on-site, either by infiltrating runoff back into the ground, or releasing it at a controlled rate off-site (to a watercourse or sewer). Besides managing flood risk, SuDS are also increasingly advocated over traditional “hard” drainage due to the multiple benefits they can provide to water quality and ecology. However SuDS require ongoing management, and the adoption of SuDS schemes by local authorities and water companies has historically been a barrier to their use, Anglian Water, who have responsibility for waste water infrastructure across South Kesteven, are currently producing a “SuDS for Adoption” manual, which will encourage good design of SuDS and mechanisms for adoption.

There are a wide variety of SuDS techniques, which are suitable in different settings and for different scales of development. Individual components should be combined together to provide a multiple-stage treatment process at increasing scale. The suitability of SuDS for use on potential development sites should be based on an assessment
of key influences including land use, site characteristics, catchment characteristics and amenity and environmental requirements (as identified by Woods-Ballard et al., 2007 in *The SuDS Manual*).

Land use is considered to be a dominant factor, as it influences the volume of water required to be attenuated, the likelihood of pollution and contaminants, and the potential for infiltration to occur. Indications of the most suitable techniques for each site cannot be made as part of a strategic level assessment, and site-specific Flood Risk Assessments and Drainage Assessments are required to provide the required recommendations. Therefore the applicability of SuDS techniques in the SFRA can only be assessed through the consideration of regional characteristics relating to the hydrology and geology.

SuDS can include a variety of systems, which either attenuate runoff and release it at a controlled rate in to the receiving sewer or watercourse, or allow infiltration back in to the ground. This second option is considered preferable because it reduces the total volume of runoff discharged to rivers downstream. It is given priority over drainage to watercourses and sewers in the Building Regulations 2000 and reinforced in PPS25. The main catchment characteristics that influence whether infiltration SuDS can be used include the infiltration potential of the soils and geology, and the risk of contaminating groundwater. These are discussed in more detail below.

Advice on specific SuDS techniques and the SuDS “management train” can be obtained from CIRIA Report C697 *The SuDS Manual* (Woods-Ballard et al., 2007). Reliable information can also be obtained from the internet at:


**Infiltration Potential**

As discussed in Section 6.2, Figures 20 and 21 give an indication of the infiltration potential across the district. Areas shown as having medium or high infiltration potential are the most likely to be suitable for using infiltration SuDS. However even in areas which this high-level mapping shows to have low infiltration potential, there may be smaller areas of, for example, higher permeability drift deposits, that can be suitable for infiltration. Therefore except in well-recognised areas of impermeable soils, all new developments should consider the option of using infiltration SuDS at the site-specific level (e.g. by carrying out infiltration tests), and should carry out more detailed assessments of the soils and geology.

**Contamination Potential**

Infiltration of surface runoff from developments is restricted where there may be an unacceptable risk of contamination to an underlying aquifer, specifically for sites within Source Protection Zones (SPZs), which are located around major public water supply abstractions. Each abstraction has three zones associated with it, which have different requirements in terms of the quality of the water that can be discharged to it and consequently the types of development from which runoff may infiltrate. **Table 6.1** shows the development types that are
permissible in each zone and the techniques required to control pollution before it is discharged, based on recommendations from the CIRIA Report 156 Infiltration Techniques (1996).

Figures 20 and 21 show the coverage of SPZs across the district. Large proportions of the district are covered by an SPZ, although the majority is Zones II or III, which are less restrictive and should not restrict infiltration from residential developments. However most of Bourne is within Zone I and this could be very restrictive for anything other than roof drainage.

### Table 6.3  Recommended Discharges for Source Protection Zones

<table>
<thead>
<tr>
<th>Impermeable Area</th>
<th>Zone I (Inner Zone)</th>
<th>Zone II (Outer Zone)</th>
<th>Zone III (Total Catchment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Drainage</td>
<td>No objection (provided for sole use of roof drainage)</td>
<td>No objection</td>
<td>No objection</td>
</tr>
<tr>
<td>Public/Amenity</td>
<td>Not acceptable</td>
<td>Acceptable</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Large Car Parks</td>
<td>Not acceptable</td>
<td>Acceptable (with interceptor)</td>
<td>Acceptable (with interceptor)</td>
</tr>
<tr>
<td>Lorry Parks</td>
<td>Not acceptable</td>
<td>Presumption Against</td>
<td>Acceptable (with interceptor)</td>
</tr>
<tr>
<td>Garage Forecourts</td>
<td>Not acceptable</td>
<td>Presumption Against</td>
<td>Acceptable (with interceptor)</td>
</tr>
<tr>
<td>Major Roads</td>
<td>Not acceptable</td>
<td>Presumption Against. Acceptable only in exceptional circumstances</td>
<td>Acceptable only if investigation favourable and with adequate precautions</td>
</tr>
<tr>
<td>Industrial Sites</td>
<td>Not acceptable</td>
<td>Presumption Against</td>
<td>Acceptable only if investigation favourable and with adequate precautions</td>
</tr>
</tbody>
</table>

### 6.3  Redevelopment in Flood Zones 2 or 3

Although it is anticipated that the vast majority of development in South Kesteven can be located outside areas of significant fluvial flood risk, some instances of redevelopment in Flood Zones 2 or 3 may occur if the Sequential and Exception Tests can be satisfied. This falls under Step 5 of the flood risk management hierarchy (“mitigate”), and should only be reached when all other steps have been addressed. Guidance on redevelopment in Flood Zones 2 or 3 is provided in the PPS25 Practice Guide, Section 4.33-4.35.

### 6.3.1  Flood Resistance and Resilience

In the case of redevelopment occurring in Flood Zone 2 or 3, flood resistance measures for residential developments would be required to the following minimum standard:
• All floor levels must be above the predicted flood level for a 1% annual probability event, with a freeboard allowance of between 300-600 mm (to be confirmed by the Environment Agency);

• A safe, and preferably dry access and evacuation route must be provided up to the 1% annual probability event.

For lower vulnerability developments (e.g. commercial uses), some internal flooding may be permitted (although not encouraged), but flood resistance and resilience measures should be incorporated at the design stage. These can reduce the impacts should inundation occur. Details of flood resilient design can be found in Communities and Local Government, 2007 *Improving the flood performance of new buildings: flood resilient construction*.

The Environment Agency advises against using land raising in Flood Zones 2 and 3 as a method for achieving the required floor levels and/or access. If land raising were to be proposed for any reason, floodplain compensatory storage would be required (as discussed below).

### 6.3.2 Loss of Floodplain Storage

In order to comply with part 3 of the Exception Test and ensure that flood risk is not increased elsewhere, it is necessary within the design of any redevelopment to ensure that there is no net loss of floodplain storage. Availability and effectiveness of floodplain storage will be affected by both the location and design of buildings in comparison to the existing site configuration. The design of any developments in Flood Zone 3, having been justified through the application of the Sequential Test, will need to be discussed with the Environment Agency.

### 6.3.3 Development in the Vicinity of a Main River

Development in the vicinity of a main river requires approval from the Environment Agency (even when not located in Flood Zones 2 or 3). Flood Defence Consent will be required when works are proposed that are in, over or under a Main River or within 9 m of Main River. Furthermore, consent will also be required for works within an ordinary watercourse when they are likely to affect flow. All Main Rivers in the district are marked on Figure 1, along with the ordinary watercourses that the Internal Drainage Boards maintain.

### 6.4 Groundwater flooding

Developments located in areas at known risk of groundwater flooding should not have basements, since these are the most likely locations of flooding before groundwater reaches the surface. The flood resilience measures described above should also be applied to areas at risk of groundwater flooding.

### 6.5 Future Proofing

It is important that new developments, particularly in the higher risk flood zones, are designed in a precautionary manner, given the possible range of potential climate change impacts that may occur. Proposed flood mitigation
measures should be reviewed at the detailed FRA stage, paying particular attention to the potential implications of future changes in climate and land use. The application of the precautionary principle and the provision of freeboard and flood resistance and resilience in buildings can mitigate future increases in flood risk at relatively low cost at the design and construction stage.
7. Flood Risk and Development in Grantham

7.1 Scope of Level 2 Assessment

A Level 2 assessment is required for Grantham for use in the Core Strategy. The remaining areas of the district, including additional sites in Grantham that do not form part of the Grantham Growth Point programme or the Core Strategy, will be considered separately at a later date for use in the Area Action Plans.

Consideration is given to flood risk issues across the whole of Grantham, while the focus in terms of proposed development sites is limited to the Southern and Northwest Urban Extensions defined in the Grantham Growth documents.

7.2 Sources of Flooding in Grantham

Figures 23 and 32 have highlighted that some of the potential allocation sites in Grantham lie within, or overlap, Flood Zones 2 or 3. The sequential test should therefore be undertaken to steer development away from those areas of risk. In addition, the sequential test should consider reliable information regarding locations at risk of other sources of flooding. Section 3 has indicated that all potential sources of flooding may occur in Grantham. These are discussed in the rest of this section, and include:

- Fluvial flooding from the River Witham, Mow Beck, Witham Brook and Barrowby Beck;
- Groundwater flooding in the Harrowby Hill area;
- Historic incidences of surface water flooding and drainage incapacity at a variety of locations;
- Risk of flooding from infrastructure associated with Grantham Canal and a balancing lagoon at Great Gonerby.

7.2.1 Modelled Fluvial Flood Risk

Figure 23 has shown that the town centre and Southern development areas overlap with Flood Zones 2 and 3. However, since these are large areas, not all of which will be developed or redeveloped, it should be possible to use the sequential approach within these areas to steer development away from the areas of fluvial flood risk. Figure 8 indicates that the extent of flooding through Grantham, particularly the north, is likely to increase due to the impacts of climate change. It will therefore become increasingly important to consider flood risks around the outer edge of Flood Zone 2.

Of the smaller potential allocation sites, one site intersects with Flood Zone 3a and three further are at least partly in Flood Zone 2. Application of the sequential test to allocation sites in Grantham will determine whether
development can be undertaken at these sites, and which vulnerability of land uses are appropriate. If development at these locations is unavoidable then the sequential approach should be applied within the site, to steer access and built areas away from Flood Zones 2 or 3.

7.2.2 Un-modelled Tributaries

Modelling of the River Witham originally included only the main channel, without tributaries. As a result, the Environment Agency Flood Maps currently do not show Flood Zones associated with a number of tributaries. At the time of writing this report, model outputs had not been obtained for Mow Beck, Barrowby Stream or the Witham Brook.

Mow Beck

Mow Beck flows from the southwest, through the Canalside area, and then beneath a culvert through the town centre, where it discharges to the River Witham. This beck is considered to be a significant source of flood risk, and is particularly relevant given the proposed plans for regeneration of the Canalside area alongside the beck. The Environment Agency intends the modelling of Mow Beck to be carried out in this financial year, and SKDC have indicated that it is unlikely that any redevelopment of the Canalside will take place within that timescale.

A precautionary 100m buffer strip has been defined around Mow Beck, which is shown in Figure 2 and was used in the production of Figures 23 and 32. A width of 100m on either bank was selected through consideration of the topography and comparison to mapping issued with the original 2004 SFRA.

Any developments within this buffer strip that are put forward for planning prior to the modelling being carried out should be treated on a precautionary basis. Developments should either be required to carry out their own site-specific flood risk assessment (which would include hydraulic modelling of the beck), or advised to wait until the Environment Agency modelling has been completed.

Barrowby Stream

Barrowby Stream flows through west from Barrowby, through west Grantham. It is culverted beneath the town centre, and emerges from the Mow Beck culvert to enter the River Witham. No Flood Zones associated with this stream were defined in the original 2004 SFRA, but the Environment Agency are in the process of modelling the stream. Flood Zones associated with the stream will be available in this financial year.

A precautionary 50m buffer strip has been defined around Barrowby Stream, which is shown in Figure 2 and was used in the production of Figures 23 and 32. A width of 50m on either bank was selected for Barrowby Stream through consideration of the topography (which comprises a well-defined valley).

Figures 23 and 32 show that there are two potential allocation sites lying at least partly within the precautionary buffer strip. As for Mow Beck, any developments within this buffer strip that are put forward for planning prior to
the modelling being carried out should be treated on a precautionary basis. Developments should either be required to carry out their own site-specific flood risk assessment (which would include hydraulic modelling of the beck), or advised to wait until the Environment Agency modelling has been completed.

7.2.3 Other Sources of Flooding

Figure 32 shows a summary of the potential allocation sites that are either in Flood Zones 2 or 3, and also shows those that are in close proximity to sites that have experienced historic flooding (from any source) in the past. These additional potential sources of flood risk should if possible be considered during the sequential test process, and should be made a focus of any site-specific FRAs in those locations.

Groundwater Flooding

There are a number of potential allocation sites around the base of Harrowby Hill where groundwater flooding could be a risk. Basements should not be allowed in these areas, and site-specific flood risk assessments should be required at these locations to consider the groundwater flooding risk.

Infrastructure Failure

As discussed in Section 4, the potential allocation sites around Grantham Canal and downstream of the balancing pond at Great Gonerby require further attention to consider the risk of infrastructure failure.

Great Gonerby

The balancing lagoon at Great Gonerby, at approximately SK 902386, was built with a new development approximately 10 years ago. It has not been formally adopted by SKDC, but the developer is no longer in business and it is expected that SKDC will take responsibility for its repairs. The reservoir has already failed on one occasion and although the area affected has been repaired, there are still weaknesses in the dam that need addressing.

There are potential allocation sites downstream of the lagoon, which would be at risk of flooding in the event of another failure. It is recommended that development downstream should not occur unless modelling of a breach scenario has been carried out as part of a Flood Risk Assessment and avoidance of the areas at risk has been shown. A standard width avoidance area, within which an FRA should be required, is shown in Figure 32.

The current loading on the lagoon should not be further increased. In order to achieve this, developments upstream of the lagoon should be stringently required to achieve greenfield runoff rates. The buffer zone shown in Figure 32 also shows the upstream area of consideration.
Grantham Canal

Historic leakages have occurred from the Grantham Canal on the 1km stretch between the A1 and Earlsfield. SKDC are undertaking repair work in stages, and in the mean time have lowered the water levels in the canal to reduce the risk. Once the repair work has been completed, the levels will be raised again as part of an ongoing programme to restore the entire length of the canal.

Overflow from the canal is to the Mow Beck, and it is likely that the area at risk of flooding from failure of the canal would be similar to that from Mow Beck. It is recommended that a canal failure scenario should be incorporated in to modelling of the Mow Beck to investigate the likely extent of flooding. This should be used to carry out a Flood Risk Assessment for the Canal Basin area. Until these local investigations have been undertaken, the area of caution around Mow Beck should be taken to also apply to the canal.

7.2.4 Surface Flooding

Historic incidences of surface flooding were discussed in Section 4 and shown in Figure 12. Figure 32 shows that a number of potential allocation sites in Grantham are located in areas that have historically experienced flooding (these are the sites shown with hatching). In addition there is a concern amongst the responsible authorities (including Upper Witham IDB, Anglian Water, SKDC and the Environment Agency) that there is increasing strain on drainage capacity in Grantham. It is therefore considered that more stringent requirements than those imposed by PPS25 should be put in place for surface water management in Grantham.

PPS25 requires that runoff from new developments should not be increased beyond the existing rates and volumes of runoff, and Section 5.50 of the PPS25 Practice Guide states that “Developers are strongly encouraged to reduce runoff rates from previously-developed sites as much as is reasonably practicable.” It is recommended that in order to manage the increasing demand on drainage capacity, a return to greenfield runoff rates should be sought for all new developments in Grantham wherever possible.

In order to regulate whether proposals for surface water management on new developments are likely to be effective, site-specific flood risk assessments should be undertaken for proposed developments with a site area greater than 0.5 ha. It is recommended that they should also be carried out for sites with a known history of drainage and surface water flooding problems, as identified in Figure 12.

The use of SuDS is to be strongly encouraged. Infiltration SuDS should be used where possible, but since the infiltration potential is often low, particularly away from the main river valley, infiltration tests should be required as part of a drainage assessment. Where the infiltration capacity is found to be insufficient to take all runoff, above-ground storage should be encouraged where possible. Source-control techniques such as green roofs should

8 It is recognised that the ability to achieve a return to greenfield runoff rates may be limited on small sites due to the lack of space to incorporate attenuation storage. However evidence should be provided that these options have been considered.
also be encouraged. The use of SuDS, and consideration of ongoing management, must be recognised at an early stage of planning, to ensure that drainage and storage can be integrated into the design. Further advice on SuDS design and adoption will be provided on publication of Anglian Waters’ “SuDS for Adoption” manual. Agreement on adoption will help to improve the long-term maintenance of SuDS, ensuring that their effectiveness does not reduce over time.

Known historical problems with managing surface water and flooding suggest that improved cooperation between all responsible authorities would be beneficial. This includes SKDC, Lincolnshire County Council (for highways), the Environment Agency and Anglian Water. Ideally, a Surface Water Management Plan (SWMP) should be undertaken for the town to ensure that an integrated and manageable drainage policy is put in place.

### 7.3 Flood Risk in Potential Development Areas

#### 7.3.1 Southern Quadrant Urban Extension

**Description of Development**

The Southern Quadrant development is intended to be a mixed used development, providing up to 4,000 homes along with shops, schools, open space and community facilities. Access to the A1 and a new east-west relief road are both intended as part of the plans.

**Fluvial Flood Risk**

The Southern Quadrant Urban Extension straddles the River Witham, and as a result has a stretch of Flood Zones 2, 3a and 3b passing through the site from south to north. The site is large and it is anticipated that application of the sequential approach within the urban extension area can ensure that no development has to take place in Flood Zones 2 or 3.

The main concern with fluvial flood risk at this site is likely to relate to access and the connection between the parts of the site to the west and east of the river. The proposed east-west relief road will necessitate a river crossing, and it is possible that other bridges may be desired to improve accessibility. There will be a requirement for safe access and egress to be provided at least for a 1 in 100 year plus climate change flood event, and ideally this should involve an access route that remains dry. Therefore, it should be possible to access all parts of the development without having to cross the river and its floodplain during a flood (i.e. by the access road to each part of the development being from the main road on the same side of the river as the development). Any bridges across the river must be constructed to be higher than the modelled flood level of the River Witham at the proposed location, with its support structures located entirely outside Flood Zones 2 or 3. If any part of the structure is proposed to be located within Flood Zones 2 or 3, then compensation storage will be required.
Surface Water Management

Due to the large size of the site and its currently undeveloped nature, there are likely to be significant increases in impermeable area and hence surface runoff. As the majority of the site is currently greenfield, PPS25 requires that greenfield runoff rates should be maintained following the development, which will require attenuation of surface runoff. It will be particularly important for developments in this location to adhere to those requirements, since runoff from the site will flow down the steep valley sides, directly enter the River Witham, and flow in to Grantham, thereby potentially increasing the flood risk to urban areas within the town. Both the rates and total volumes of runoff should be considered.

Figure 20 indicates that the soils and geology underlying the site have a high or moderate infiltration potential, and therefore it is likely that infiltration SuDS could be used to control runoff. However, the use of SuDS in close proximity to the river may not be appropriate due to a shallow water table. The site does lie in an SPZ Zone III, but infiltration from residential areas should still be allowable in this case. The need for on-site storage should be considered as an integral part of the site layout and open space design.

7.3.2 Poplar Farm (Northwest Quadrant) Urban Extension

Description of Development

The Poplar Farm development is intended to be predominantly residential, providing up to 3,500 dwellings. Some additional employment, educational and community facilities will also be provided.

Fluvial Flood Risk

The Poplar Farm Urban Extension is located completely outside the fluvial Flood Zones, and therefore has no formal restrictions in terms of application of the sequential test. However, the ordnance survey map shows a drainage channel bisecting the site, which flows in to the IDB-maintained Running Furrows watercourse. The flood risks associated with this channel should be considered in a site-specific flood risk assessment.

Surface Water Management

The main flood risk concern for development in this location is regarding surface water and drainage capacity. There have been historic occurrences of flooding due to drainage capacity by the railway bridge, and the indicative surface water modelling (Figure 16) shows that the directions of drainage will cause a tendency for water to flow to the northeasterly side of the site and pool behind the railway line. When planning the development and its drainage design, these runoff patterns should be given consideration.

As Figure 20 suggests, the site is in an area dominated by clay, that has low infiltration potential, and this could restrict the use of infiltration SuDS. However it is recommended that a site-specific flood risk assessment should be carried out of the site to consider the drainage requirements and potential for using infiltration in more detail. If
infiltration techniques are not possible, then an above-ground storage system should be used where possible: this should be considered as an integral part of planning the site layout, and incorporated into the open space design.

### 7.3.3 Other Allocation Sites in Grantham

All allocation sites will be subject to a Sustainability Appraisal and the Sequential Test (and where applicable the Exception Test). Flood Risk implications for the other main proposed development areas in Grantham are outlined below.

**Canal Basin**

The Canal Basin is a currently under-utilised area of brownfield land, which is intended to be redeveloped to a mixed use area. The sites associated with the Canal Basin are, as the name suggests, in the vicinity of the Grantham Canal, and also of Mow Beck. Figure 32 shows that the sites are at potential risk of flooding from both Mow Beck and the canal. As discussed in Section 7.2, it is recommended that a Flood Risk Assessment should be carried out for the proposed development area to consider the appropriate distribution of land uses. This should use the outputs of the flood modelling carried out by the Environment Agency for Mow Beck, which is due to be completed by March 2009. Until the modelling has been completed and the Environment Agency’s flood maps updated, the area highlighted as “precautionary” on Figure 32 should not undergo any development. Potential developers will be advised to wait until modelling has been carried out.

**Manthorpe**

The potential allocation sites at Manthorpe will be put forward by private developers. Along with one site in Great Gonerby, these sites have been highlighted as being as potential risk at flooding due to their location downstream of a balancing pond in Great Gonerby. Historic flooding due to overtopping of the pond, and ongoing concerns regarding its stability, indicate that this is a significant risk. Although SKDC are likely to take responsibility for the necessary repairs to the pond, developers of the Manthorpe sites will be required to carry out a Flood Risk Assessment including breach modelling to illustrate the avoidance or, if necessary, mitigation of risk in the proposed developments.

**Barrowby Stream**

There are two potential allocation sites in west Grantham that may potentially be at risk of flooding from Barrowby Stream. As discussed in Section 7.2, flood modelling of the stream by the Environment Agency is due to be completed by March 2009. Until the modelling has been completed and the Environment Agency’s flood maps updated, the area highlighted as “precautionary” on Figure 32 should not undergo any development. Potential developers will be advised to wait until modelling has been carried out.
8. Summary

8.1 Overview

This SFRA has considered all sources of flooding across South Kesteven, and the areas to which they constitute a risk. Fluvial flooding has the highest profile and is the most obvious visible source of flood risk. However, historic records show that incidences of surface water flooding (often from inadequate or blocked drainage) are common across the district. In addition, some localised areas experience groundwater flooding or are at risk from infrastructure failure.

Planning policy is still most strongly influenced by fluvial flood risk, due to the clearer definition of areas at risk in comparison to other sources of flooding. The Environment Agency’s Flood Zones are the main source of information in applying the Sequential Test, as defined by PPS25. Potential allocation sites have been plotted on maps to show their location in relation to Flood Zones 2 or 3. This has shown that although a number of sites do overlap with Flood Zones 2 or 3, in the majority of cases only a small proportion of the site is at risk from fluvial flooding. This indicates that application of the sequential test should be able to successfully steer the vast majority of development into Flood Zone 1.

It was noted that there are currently no Flood Zones associated with the Mow Beck or Barrowby Stream in Grantham, and a precautionary approach has been recommended in the vicinity of these channels until modelling has been carried out and Flood Zones defined. The highlighted area surrounding Mow Beck should also be considered as potentially being at risk from flooding from failure of the Grantham Canal.

A more detailed assessment of flood risk in Grantham has shown that in addition to fluvial flood risk, a number of potential development sites are at risk from other sources of flooding. Wherever possible, these additional sources should be incorporated into the sequential test or highlighted as a focus for site-specific flood risk assessments. Groundwater flooding is known to occur on Harrowby Hill: in this case it is likely that the recommendation of flood resistance measures will be more appropriate than total prevention of development. An area downstream of Great Gonerby has also been identified to be at risk of flooding from infrastructure failure, and this should be accounted for in planning decisions.

A number of problem areas with surface water management have been highlighted in Grantham, as well as in other towns and villages across the district. In order to improve regulation and management of surface water in Grantham, all new developments should aim to attain greenfield runoff rates where possible, which is likely to require the inclusion of attenuation storage or infiltration devices. Flood Risk Assessments, including an assessment of drainage, will be required for all developments greater than 0.5 ha. On a more strategic level, it is recommended that a Surface Water Management Plan be produced for Grantham to ensure cooperation between all responsible authorities and improved acceptance and adoption of SuDS.
8.2 Recommendations

8.2.1 Recommendations for Policy and Management

The following recommendations are made regarding planning policy and development control in South Kesteven:

- The Sequential Test should be applied to potential allocation sites to steer development away from areas of fluvial flood risk. Information on other sources of flooding (e.g. the surface water and historic flooding maps) and climate change should also be included where possible as a secondary level of screening within the sequential approach. Flood risk management through avoidance should be adopted wherever possible;

- Surface water management and mitigation should be considered as an integral part of planning. The following requirements for new developments should be applied through the planning process:
  - Runoff must be retained at greenfield rates for greenfield sites, and should be returned as close to greenfield as is practicably possible for previously developed sites;
  - On-site attenuation and infiltration should be required as part of any new development wherever possible. The long term maintenance of structures i.e. balancing ponds should be agreed prior to acceptance of the scheme;
  - All planning applications should include an agreed statement of how surface water is to be managed and in particular where it is to be discharged;
  - The relevant IDB should be consulted regarding any proposed development falling within IDB catchment boundaries;
  - The potential for flooding from surface runoff upstream of a development should be considered and managed through design. This is to be carried out at the masterplanning stage, using the indicative surface runoff maps.

- A Flood Risk Assessment should be required for any site that is:
  - At least partly in Flood Zones 2 or 3;
  - In an area that has historically experienced flooding from any other source;
  - Downstream of any infrastructure that the Council consider to pose a significant flood risk (notably the balancing lagoon at Lord Drive in Great Gonerby.);
  - Greater than 1 ha in total area, to provide an assessment of drainage (except for Grantham, where there are also requirements on smaller sites, as specified below).

- Flood resilient design should be incorporated into building design for:
  - Any redevelopment in Flood Zones 2 or 3;
Any development in the vicinity of sites that have historically experienced groundwater flooding, notably on Harrowby Hill in Grantham. Basements should not be permitted for developments in this area.

The following recommendations refer only to Grantham:

- A precautionary approach should be taken to development around Mow Beck and Barrowby Stream until flood modelling has been completed. During this interim period, proposed developments within the specified buffer zones should be required to either carry out their own flood modelling or wait until model outputs are available from the Environment Agency;

- A detailed assessment of flood risk in the Mow Beck and Canalside area is recommended (following completion of the EA modelling), so as to inform the baseline criteria for ‘safe’ development;

- Proposed developments within the defined buffer zone downstream of the Lord Drive (Great Gonerby) balancing lagoon should be required to undertake a Flood Risk Assessment to consider the risk of infrastructure failure. This requirement should remain in place until the SKDC Drainage Engineer is satisfied that repair works have made the lagoon safe;

- Improved management of surface water will be encouraged. All new developments will be required to achieve greenfield runoff rates where possible, and this should be particularly stringently applied to areas of Great Gonerby upstream of the Lord Drive balancing lagoon. A Flood Risk Assessment incorporating a drainage assessment should be required for all sites greater than 0.5 ha.

The Level 2 assessment included in this report refers only to Grantham. Level 2 Assessments will also be required for other parts of the district if development is likely to occur in areas identified in the Level 1 Assessment as being at significant risk of flooding. In addition, the need for increased regulation of surface water management should be considered in the rest of the district. A Level 2 assessment for Market Deeping will be required to consider residual risks of failure of the flood defences on the River Welland, as discussed in Section 3 of this report.

8.2.2 Recommendations for SFRA Review

The SFRA should be reviewed on a periodic basis and following significant changes to national or local planning policy. An initial update will be required in mid 2009, in order to:

- Incorporate the flood modelling of the Mow Beck and Barrowby Stream, and the undefended climate change scenarios;

- Carry out Level 2 assessments in the rest of district (outside Grantham) as required;

The necessity of updating the SFRA should be considered in the event of:

- Changes to national flooding policy;
- A major flooding event affecting the district.

If no other reason for reviewing the SFRA has arisen, it should be reviewed every 3 years.
9. References


Appendix A
Extracts from PPS25 (December 2006) and the PPS25 Practice Guide (June 2008)
Figure 4.1 Application of the Sequential Test at the Local level for LDD preparation

START HERE
Can development be allocated in Zone 1? (Level 1 SFRA)

Yes
Sequential Test passed

No

Where are the available sites in Zone 2? (Level 2 SFRA)-can development be allocated within them? (lowest risk areas first) (Tables D1 and D2)

Yes
Exception Test if 'highly vulnerable'

No

Where are the lowest risk available sites in Zone 3?- can development be allocated within them? (Tables D1 and D2)

Yes
Allocate, subject to Exception Test (Table D3)

No

Is development appropriate and permissible in remaining areas? (Tables D1, D2 and D3)

Yes
Allocate, subject to Exception Test (Table D3)

No

Note
1 Other sources of flooding need to be considered in Flood Zone 1
Figure 4.2 Application of the Exception Test

START HERE
Has the Sequential Test been applied?

Yes
Is the Exception Test required? (Table D3 in PPS25)

No
Do the Sequential Test. Exception test cannot be passed

Yes
Are all three criteria satisfied? (Para. D9, PPS25)

No
Appropriate development can be allocated or permitted (Tables D1, D2 & D3, PPS25 Annex D)

Yes
Development can be allocated or permitted

No
Development cannot be allocated or permitted
## Table D.2: Flood Risk Vulnerability Classification

<table>
<thead>
<tr>
<th>Vulnerability Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Infrastructure</td>
<td>Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.</td>
</tr>
</tbody>
</table>
| Highly Vulnerable | Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding.  
- Emergency dispersal points.  
- Basement dwellings.  
- Caravans, mobile homes and park homes intended for permanent residential use.  
- Installations requiring hazardous substances consent.¹⁹ |
| More Vulnerable | Hospitals.  
- Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels.  
- Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels.  
- Non-residential uses for health services, nurseries and educational establishments.  
- Landfill and sites used for waste management facilities for hazardous waste.²⁰  
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan. |
| Less Vulnerable | Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in ‘more vulnerable’; and assembly and leisure.  
- Land and buildings used for agriculture and forestry.  
- Waste treatment (except landfill and hazardous waste facilities).  
- Minerals working and processing (except for sand and gravel working).  
- Water treatment plants.  
- Sewage treatment plants (if adequate pollution control measures are in place). |

¹⁹ DETR Circular 04/00 – para. 18: Planning controls for hazardous substances.  

Table D.2: contd.

| Water-compatible Development | • Flood control infrastructure.  
|                             | • Water transmission infrastructure and pumping stations.  
|                             | • Sewage transmission infrastructure and pumping stations.  
|                             | • Sand and gravel workings.  
|                             | • Docks, marinas and wharves.  
|                             | • Navigation facilities.  
|                             | • MOD defence installations.  
|                             | • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.  
|                             | • Water-based recreation (excluding sleeping accommodation).  
|                             | • Lifeguard and coastguard stations.  
|                             | • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.  
|                             | • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan. |

Notes:

1) This classification is based partly on Defra/Environment Agency research on Flood Risks to People (FD2321/TR2)\(^2\) and also on the need of some uses to keep functioning during flooding.

2) Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

3) The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.
D1-D8: Sequential test

For the exception test to be passed:

a) it must be demonstrated that the development provides wider sustainability benefits to the community that
outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the ‘submission
stage’… the benefits of the development should contribute to the Core Strategy’s Sustainability Appraisal;

b) the development should be on developable previously-developed land or, if it is not on previously-developed
land, that there are no reasonable alternative sites on developable previously-developed land; and

c) a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where
possible, will reduce flood risk overall.
Appendix B
Key to Historic Flooding Maps
<table>
<thead>
<tr>
<th>Name</th>
<th>Street</th>
<th>X,Y co-ordinates</th>
<th>Type of Flooding</th>
<th>Cause of Flooding</th>
<th>Summary of Type of Flooding</th>
<th>Action taken</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claypole</td>
<td>Oster Fen Lane</td>
<td>485400, 349100</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Surcharging Dyke and Highway and Culvert surcharge</td>
<td>Y</td>
</tr>
<tr>
<td>Claypole</td>
<td>Stubton Road</td>
<td>485800, 348800</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Surcharging Dyke and Culvert and Highway Culvert surcharge</td>
<td>Y</td>
</tr>
<tr>
<td>Claypole</td>
<td>whole village</td>
<td>485000, 349000</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Surcharging Dyke and Culvert and Highway Culvert surcharge</td>
<td>Y</td>
</tr>
<tr>
<td>Caythorpe</td>
<td>Frieston Heath Lane</td>
<td>494200, 348100</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Surcharging Dyke system and Highway Culvert surcharge</td>
<td>Y</td>
</tr>
<tr>
<td>Long Bennington</td>
<td>Westborough Lane</td>
<td>483600, 345500</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>R Witham floodplain fluvial EA regular</td>
<td>Y</td>
</tr>
<tr>
<td>Foston</td>
<td>Goosegate Lane</td>
<td>486100, 343100</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Pluvial. watercourse surcharged</td>
<td>Y</td>
</tr>
<tr>
<td>Allington</td>
<td>Bottom Street</td>
<td>485800, 340200</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Surcharging Dyke and Culvert and Highway Culvert surcharge</td>
<td>Y</td>
</tr>
<tr>
<td>Allington</td>
<td>Gonerby Lane</td>
<td>486300, 340200</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Surcharging Dyke and Culvert and Highway Culvert surcharge</td>
<td>Y</td>
</tr>
<tr>
<td>Heydour</td>
<td>St Michaels Church</td>
<td>500900, 339600</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Pluvial. Highway Culvert enlarged</td>
<td>Y</td>
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<td>Oasby</td>
<td>South Barn &amp; Corner Cottage</td>
<td>500400, 339100</td>
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<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Surcharging Culvert and Separate Overland Flow. Surcharge Culvert enlarged</td>
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</tr>
<tr>
<td>Aisby</td>
<td>Main Street</td>
<td>501200, 338800</td>
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<td>Flooding of highway</td>
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<td>Lord Drive</td>
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<td>Surface and Culvert surcharged</td>
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<tr>
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<td>Orchard Drive/The Haverlands</td>
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<td>Five Gates Lane</td>
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<td>Pluvial across Highway (no drains)</td>
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<td>Sedgebrook Road</td>
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<td>Whole Village</td>
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<td>Station Road</td>
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<td>Flooding of highway</td>
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<td>Birthorpe Road</td>
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<td>Flooding of highway</td>
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<td>Fen Road</td>
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<td>Coronation Road</td>
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<td>Blocked Culvert Repairs - But Will Require More in Future</td>
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<td>Surchaging Culvert and Separate Overland Flow. Surcharge Culvert enlarged</td>
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<td>Thurlby</td>
<td>Swallow Hill</td>
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<td>Flooding of highway</td>
<td>Surcharging Dyke and Culverts Surface Highway Improvements Regular but Alleviated</td>
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<td>Manthorpe</td>
<td>Manthorpe Bridge</td>
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<td>Flooding of highway</td>
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<td>Cemetery</td>
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</tr>
<tr>
<td>Stainfield</td>
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<td>Flooding of highway</td>
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<td>Flooding of highway</td>
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<td>South Road</td>
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<td>Flooding of highway</td>
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<td>Barholm Road</td>
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<td>Flooding of highway</td>
<td>Watercourse Surcharges Surface</td>
<td>Y</td>
</tr>
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<td>Stamford</td>
<td>Essex Road</td>
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<td>Flooding of highway</td>
<td>Watercourse Surcharges Inadequate Culvert and Groundwater Property Owners Advised</td>
<td>Y</td>
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<td>Stamford</td>
<td>Northumberland Avenue</td>
<td>502500, 307500</td>
<td>Surface</td>
<td>Flooding of Highway</td>
<td>Flooding of highway</td>
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</tr>
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<td>Stamford</td>
<td>New Cross Road</td>
<td>502700, 307400</td>
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<td>Flooding of highway</td>
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<td>Flooding of highway</td>
<td>Waterlogging at Base of Hill Groundwater None-Hope to Improve With Next Phase of Development</td>
<td>Y</td>
</tr>
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<td>Stainfield</td>
<td>Kirkby underwood Road</td>
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<td>Flooding of highway</td>
<td>Pluvial Flows and Springs Surface Works Pending No Reports</td>
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<td>Bourne</td>
<td>Beech Avenue</td>
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<td>Flooding of Highway</td>
<td>Flooding of highway</td>
<td>Watercourse Surcharges Surface</td>
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<td>Bourne</td>
<td>South Road</td>
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<td>Flooding of highway</td>
<td>Watercourse Surcharges Inadequate Culvert and Groundwater Property Owners Advised</td>
<td>Y</td>
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</tbody>
</table>
Appendix C
Surface Runoff Modelling Methodology
In order to further understand overland flow paths within South Kesteven, an analysis to identify potential drainage paths was conducted as part of this SFRA. The analysis focused on the four main urban areas of the district, where the majority of impermeable surfaces and drainage pressures are found: Grantham, Stamford, Market Deeping and Bourne. Separate models were run for each town.

The analysis was undertaken by using existing topographic information in the form of a Digital Terrain Model (DTM), and simulating a heavy rainfall event over areas marked for analysis. The ground surface was assumed to be completely impermeable, so all rainfall drained to local low points in the topography and flow gradually accumulated along increasingly defined flow paths.

SAAR (Synthetic Aperture Radar) topographic data was used to form the surface. This has a poorer vertical resolution compared to LiDAR data, which is preferentially used for spatial modelling and mapping. However LiDAR coverage was not available over the whole of the model areas, and therefore SAAR was used instead because it has complete nationwide coverage.

A 100 year design rainfall depth was derived using the FEH software for each of the urban areas. Rainfall depths for a range of durations were extracted. The FEH percentage runoff losses model was then used to convert the total rainfall into effective rainfall, which was an approximate way of accounting for how much rainfall became runoff. The model used catchment descriptors to estimate effective rainfall, considering the influences of catchment slope, catchment length, standard percentage runoff (for soils), catchment wetness index, and urban cover. Urban cover was assumed to be uniform in the four main urban areas. Effective rainfall was then increased to account for the influence of climate change. The formalised piped drainage network was not considered in the estimations of rainfall, or in the subsequent surface runoff modelling.

TUFLOW 2D modelling software was used to simulate the rainfall over the terrain, and the resulting output is provided in the main report. The model output indicates potential flow routes that do not necessarily correspond to perennial streams. It also identifies locations where flows become constrained or where depressions exist, thereby resulting in pooling of surface water. Following an extreme storm it may be that previously unknown flow routes, upon which development may now be placed, become active. This could cause a potential flood risk to any development located in that area. The modelling is broadscale in nature, uses relatively coarse topographic data, and has many simplifying assumptions, which makes it unsuitable for use in studies such as detailed urban flood path modelling. However it does provide a useful indication of flow paths and is another dataset to draw on in Stage 2 of the SFRA, particularly if there is a lack of more detailed information.

**Key Assumptions/Limitations**

The main key assumptions associated with this broadscale method of modelling are outlined below.

- The SAAR topographic data is not as accurate in the vertical or horizontal domains as LiDAR data. As a result local variations such as kerbs and walls may not be accounted for;
• Runoff parameters are purely based on catchment descriptors provided on the FEH CD-ROM. Runoff parameters are kept constant for each model area (but vary between model areas/towns);

• A universal surface roughness is applied across the modelled areas;

• No account is taken of the existing drainage system. Therefore the modelling represents a worst-case scenario that shows the potential areas of flooding that are likely to occur over impermeable surfaces with blocked or overwhelmed drainage. For this reason, no absolute depths are assigned to the model outputs, only an indication of extent.

Model Output

Since the entire model area is wetted during simulations, a critical depth of rainfall was removed from the model output. This was done in order to present a more realistic output, rather than the model output which would have otherwise shown the entire model area as wet. A depth of runoff of 0.02m was therefore removed from each of the model area results. This depth of rainfall removed approximates the depth of effective rainfall falling onto any point in the model area. Areas are only considered as flow pathways once surface water runoff starts accumulating and running over them.
Appendix D
GIS Database
The information presented in the SFRA maps is also provided on an accompanying CD-ROM in MapInfo format. This allows the information to be viewed in a GIS, providing greater flexibility in terms of assessing the characteristics of both existing allocation sites and future windfall sites. Details of flood risk, climate change implications, historic flooding and drainage assessments are included. Table D1 describes all the files that are contained within the database.

### Table D1  Files Included in the GIS Database

<table>
<thead>
<tr>
<th>Folder Name</th>
<th>Files</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change</td>
<td>FZ2_CC_clip.tab</td>
<td>The likely future extent of Flood Zones 2 and 3, once climate change impacts are accounted for. This should be updated with the Environment Agency’s undefended climate change runs when they have been carried out</td>
</tr>
<tr>
<td></td>
<td>FZ3_CC_clip.tab</td>
<td></td>
</tr>
<tr>
<td>Flood zones</td>
<td>FZ2.tab</td>
<td>The current extent of Flood Zones 2, 3 and 3b. Flood Zone 3b has been defined using the flood extent from the Environment Agency’s “defended 1 in 25 year” model run of the Upper Witham and the Welland. This should be replaced with the most up to date files from the Environment Agency as and when they are provided.</td>
</tr>
<tr>
<td></td>
<td>FZ3.tab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FZ3b.tab</td>
<td></td>
</tr>
<tr>
<td>GW vulnerability</td>
<td>gwv_100k.tab</td>
<td>Groundwater vulnerability map, colour coded (as per Section 6 of the report) to indicate the infiltration potential</td>
</tr>
<tr>
<td>Historic flooding</td>
<td>Historic_flooding.tab</td>
<td>Locations of historic recorded flood events in the district, including mapped distributions of fluvial flooding and local events reported to SKDC</td>
</tr>
<tr>
<td></td>
<td>Historic_flooding_buffer.tab</td>
<td></td>
</tr>
<tr>
<td>IDB catchment boundaries</td>
<td>IDB_Catchments.tab</td>
<td>Boundaries of the Internal Drainage Boards operating in the district</td>
</tr>
<tr>
<td>IDB rivers</td>
<td>IDB_Drains.tab</td>
<td>Watercourses maintained by Internal Drainage Boards</td>
</tr>
<tr>
<td>Main rivers</td>
<td>EA_main_rivers.tab</td>
<td>Main rivers</td>
</tr>
<tr>
<td>Precautionary area</td>
<td>Precautionary_area.tab</td>
<td>The area around Mow Beck and Barrowby Stream that should be treated with caution until the Environment Agency have modelled those tributaries.</td>
</tr>
<tr>
<td>Market Deeping</td>
<td>Raised_def_MD</td>
<td>Locations of raised defences in Market Deeping with a 300m buffer applied, within which flood risk assessments should be required until further modelling has been carried out.</td>
</tr>
<tr>
<td></td>
<td>300m_buffer_MD</td>
<td></td>
</tr>
<tr>
<td>Site allocations</td>
<td>Site_allocations_flood_risk.tab</td>
<td>File showing the flood risk considerations for all potential allocation sites in the district. Further details are provided in Table D2.</td>
</tr>
<tr>
<td>SPZs</td>
<td>SPZs.tab</td>
<td>Locations of Source Protection Zones: affects the type of SuDS that can be used, as discussed in Section 6</td>
</tr>
<tr>
<td></td>
<td>SKDC_Boundary.tab</td>
<td>District boundary</td>
</tr>
</tbody>
</table>

An attribute database has been created to provide easy access to flood risk information for specific allocation sites. Table D2 details all the attribute fields contained within the database. The information regarding fluvial flood risk at each site refers to the maximum flood risk at the site: this allows immediate identification of sites that require consideration of flood risk. Further detail regarding the distribution of fluvial flood risk across the site can then be obtained by comparison to the other fluvial flood risk shapefiles included in the database.
Table D2 Attribute Database for Site Allocations

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin_of_data</td>
<td>Name of the tab file from which the allocation site originated</td>
</tr>
<tr>
<td>Area_ha</td>
<td>Site area in hectares</td>
</tr>
<tr>
<td>EA_main_river_within_20m</td>
<td>Flagged if the site is within 20m of a main river: building within this distance of the river may be restricted. Consult with Environment Agency.</td>
</tr>
<tr>
<td>Historical_flooding</td>
<td>Flagged if the site is located in the vicinity of a historic flooding incident</td>
</tr>
<tr>
<td>Source_of_historical_flooding</td>
<td>Details the type of historic flooding if relevant</td>
</tr>
<tr>
<td>Max_FZ_within_site</td>
<td>Identifies the maximum flood risk within the site</td>
</tr>
<tr>
<td>Max_FZ_within_site_including_CC</td>
<td>Identifies the likely maximum flood risk within the site including the influence of climate change</td>
</tr>
<tr>
<td>Site_greater_1ha</td>
<td>Flagged if the site is greater than 1 ha</td>
</tr>
<tr>
<td>FRA_required</td>
<td>Flagged if a flood risk assessment is required for the site for any reason</td>
</tr>
<tr>
<td>Infiltration_potential</td>
<td>Supporting information for SuDS design: identifies the infiltration potential of the soils and geology at the site</td>
</tr>
<tr>
<td>In_an_SPZ</td>
<td>Supporting information for SuDS design: identifies if infiltration may be restricted because the site is in an SPZ</td>
</tr>
</tbody>
</table>

The Environment Agency provide regular updates to the Council of their Flood Maps. The Flood Zone files contained within this database can be replaced with Environment Agency updates when they become available, without affecting the rest of the database.
Appendix E
Market Deeping Residual Risk Zones
Appendix E
Residual Risk Zones in the Deepings

South Kesteven District Council
Strategic Flood Risk Assessment

May 2009
23769-B44 musgh

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